

PRELIMINARY RESULTS ABOUT THE EFFECT OF STORAGE PERIOD ON THE HATCHING PROCESS OF THE HEN EGGS

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Abstract

In the breeding and production of broilers, eggs for hatching are subject to different storage conditions. This work aims to show the effects of different levels of storage conditions and preheating of hen eggs from Ross 308 hybrid and to help establish a optimal program for storage and preheating of eggs. Hatching eggs had a different retention period of 3 days, 7 days or 14 days, then were preheated for 4, 8 or 12 hours at a temperature of 23 °C, 25 °C or 28 °C. These eggs were weighed at the beginning of storage and the introduction to incubate and then followed during embryonic development, the mortality of different stages was established. Following the incubation process were determined proportion of viable chick, chick yield, hatchability and hatching percentage. It concludes that batches of eggs that were stored for 3 or 7 days and then incubated, have made the best values of the indices follow its incubation and hatched chick quality. The best choice to obtain maximum results in incubation of hybrid Ross 308 from the combination of duration and storage conditions, the duration of preheating and levels of preheating of the eggs were: storage 7 days, preheating for 8 or 12 hours at 23 °C or 25 °C. Elevated values of incubation parameters have appeared also to the eggs stored for 3 days. The embryonic mortality had also values below the average batch in all stages analyzed, at the group of eggs stored for 3 days and then preheated for 4 hours at 25 °C.

Key words: egg storage period, preheating, egg incubation, hatchability, hatching percentage

INTRODUCTION

In Romania, hen eggs placed in incubation, come mostly from fewer breeding units and is often brought from great distances, reaching a maximum storage of eggs included in "fresh" category, so it is necessary to undertake a study more complete and competent regarding to the conditions of storage and preheating of hatching eggs. This paper aims to determine the physical parameters of the optimal storage and preheating eggs from commercial hybrid of meat chicken "Ross 308", depending on their storage conditions. This paper aims also to support the improvement the performance of hatching chicken eggs, by establishing a optimal polifactorial program for storage and preheating egg when incubation begins. The optimal duration of egg storage before incubation appears in the literature with different data:

- up to 21 days at 7.2 °C [10, 11], or at a temperature of 11.7 °C and relative humidity of 85% [4];

- up to 8 days at low temperature and high relative humidity [14];
- up to 7 days under standard conditions (10-20 °C and 50-80% relative humidity) [1], up to a week at a temperature between 11-16 °C and moderate relative humidity [3], to 7 days at a temperature of 15 °C and air relative humidity of 85% [4], up to 7 days if the storage temperature of the eggs is 12.78 °C and relative humidity of 75% [12];
- up to 5 days to the ideal temperature for storage of 12.77-15.55 °C and a humidity of 75-80% [4];
- up to 5 days at a temperature of 16-20 °C and a relative humidity of 65-70% [9];
- up to 4 days at a storage temperature of egg incubation at 20 °C and the relative air humidity of 75-80% [4].

Following other authors eggs can be kept different time intervals, with good hatching results, if those are kept in optimum conditions (temperature and relative humidity); it is considered that the ideal storage temperature of chicken eggs for a period greater than 4 days is

on 10 °C, range between 8-12 °C [13]. When eggs are kept and stored between 1-3 days, they must be kept at 18.3 °C and the relative humidity of 75% and when the duration of storage increases, the temperature at which eggs are kept drops to 14.7 °C and the relative humidity must be between 75-80%. At an interval higher than one week of storage conditions, hatching eggs are subject to an average temperature of 12.2 °C and the relative humidity of 80%.

The optimal time of pre-heating seems to be different: 18-24 hours [8], 16 hours [10.11], 10 hours [2] or 6 hours [5]. Preheating period is conditioned also by the eggs age, their temperature and the possibilities of raising the temperature up to 23.9-26.7 °C [13].

In specialized literature are not complex experiments covering both storage and different preheating conditions of eggs.

MATERIAL AND METHOD

This paper aims to determine which is most advantageous combination of technology on three factors: duration of storage of eggs and the preheating time and level of eggs to achieve the best results of hatching chicken eggs.

The research was conducted in „Stația de Incubație Nouă” at SC Avicola Tartasesti SA, part of Agrolu Grup, using eggs and chicks from Ross 308 hybrid. The working method consisted in analyzing the results of the hatching eggs from hens aged between 25 and 35 weeks. Eggs had a different retention period of 3 days, 7 days or 14 days. Eggs stored in this way, were then preheated for 4, 8 or 12 hours at a temperature of 23 °C, 25 °C or 28 °C.

According to the experimental design were used 27 experimental groups (batches) and 9 control (batches). Each experimental group consisted by a number of 150 eggs and a total of 1377 eggs were analyzed. Eggs were weighed at the beginning and end of storage period and then placed in the incubator. After the preheating period, eggs were incubated and then transferred from day 18 of embryonic development at the hatcher. At the end of the hatching process, it was separated chicks from the hatching debris. Chicks were then sorted according to quality, were counted, vaccinated

and placed in boxes for delivery to farms. Hatching residues were analyzed, eggs were broken and evaluated causes of embryonic mortality.

Finally the main hatching indices were calculated by assessing the activity of hatching eggs: hatchability and hatching percentage for each batch.

RESULTS AND DISCUSSIONS

Weight loss of incubated eggs in storage period. Eggs stored for 3 days decreased in weight with an average of 0.45%. Loss was accentuated with the increasing of the storage interval. Eggs stored for 7 days, have lost 1.04% and those who were the stored for 14 days, have lost 1.58% of there initially weight (Table 1).

Table 1. Weight loss of hatching eggs during storage period (%)

| Preheating program | Storage period (days) | | | Average | |
|---|-----------------------|------|------|---------|------|
| | 3 | 7 | 14 | | |
| 4 hours | 23°C | 0.37 | 1.84 | 2.17 | 1.46 |
| | 25°C | 0.24 | 1.34 | 1.86 | 1.15 |
| | 28°C | 0.38 | 0.47 | 1.53 | 0.80 |
| 8 hours | 23°C | 0.19 | 1.41 | 1.17 | 0.92 |
| | 25°C | 0.17 | 0.50 | 1.20 | 0.62 |
| | 28°C | 0.41 | 1.25 | 1.04 | 0.90 |
| 12 hours | 23°C | 0.35 | 1.52 | 2.46 | 1.44 |
| | 25°C | 0.48 | 0.67 | 1.23 | 0.80 |
| | 28°C | 1.49 | 0.35 | 1.56 | 1.13 |
| Average of experimental batches | | 0.45 | 1.04 | 1.58 | 1.02 |
| Control batch (3,7 or 14 days storage, no preheating) | | 0.11 | 1.46 | 1.04 | 0.87 |

Declines of the control batch (3,7 or 14 days storage, no preheating) were on average of 0.87%, with 0.15% less than the average of the experimental batches.

Dead embryos in phase I (1 – 8 days). Embryonic mortality increased by duration of storage of eggs (Table 2). From eggs stored for 3 days and then incubated embryonic mortality in phase I was an average of 2.67% at the experimental batches and up to 2.66% to the control batch (3,7 or 14 days storage, no preheating).

Table 2. Dead embryos in phase I (1 – 8 days) depending on the storage period of eggs (%)

| Preheating program | | Storage period (days) | | | Average |
|---|------|-----------------------|------|-------|---------|
| | | 3 | 7 | 14 | |
| 4 hours | 23°C | 2.00 | 1.34 | 7.34 | 3.56 |
| | 25°C | 3.34 | 4.00 | 8.00 | 5.11 |
| | 28°C | 4.67 | 2.00 | 14.67 | 7.11 |
| 8 hours | 23°C | 3.34 | 4.00 | 3.34 | 3.56 |
| | 25°C | 2.00 | 3.34 | 3.34 | 2.89 |
| | 28°C | 3.34 | 2.67 | 8.00 | 4.67 |
| 12 hours | 23°C | 2.00 | 1.34 | 6.00 | 3.11 |
| | 25°C | 2.00 | 4.00 | 6.00 | 4.00 |
| | 28°C | 1.34 | 2.00 | 7.34 | 3.56 |
| Average of experimental batches | | 2.67 | 2.74 | 7.11 | 4.17 |
| Control batch (3,7 or 14 days storage, no preheating) | | 2.66 | 3.33 | 10.00 | 5.33 |

In batches of eggs that were stored for 7 days, the embryos were dead in phase I at a rate of 2.74% for experimental batches and 3.33% in the control batch, the difference between the two values was of 0,59%. When eggs were of 14 days old, embryonic mortality in phase I it was, on average of 7.11%, in experimental batches and 10.00% in control batch. These values are considerably higher than that of fresher eggs. Between experimental batches, differences between eggs stored 14 days and those stored for 3 days, were of 4.44% and 4.37% less than 7 days old. There were more than 1% difference between average values of experimental batches and control batch, the difference was of 1.16%.

Dead embryos in phase II (9 – 15 days). The proportion of dead embryos in phase II to all analyzed eggs was low (Table 3). The lowest proportion was recorded in eggs stored for 3 days, of 1.12% at the experimental variations and 1.33% in the control batch. Then came the eggs stored for 7 days, the dead embryos in phase II were at the rate of 1.19% and the highest percentage was recorded for batches of eggs stored for 14 days, of 2.00%. Overall the averages of the experimental batches and control batch had similar values, the difference between the two of them was of 0.11%.

Dead embryos in phase III (16 -21 days). As far as the proportion of dead embryos in phase III, it was higher than dead embryos from phase II, but less than those from the first phase.

At the eggs of three days old, embryonic mortality in phase III was of 2.22% in the experimental batches and 3.33% for the control batch, when the eggs were not preheated (Table 4). This result shows that the relatively fresh eggs, can reduce by more than 1% the late embryonic mortality (1.11%) if it is made the preheating of the eggs.

Table 3. Dead embryos in phase II (9 -15 days) depending on the storage period of eggs (%)

| Preheating program | | Storage period (days) | | | Average |
|---|------|-----------------------|------|------|---------|
| | | 3 | 7 | 14 | |
| 4 hours | 23°C | 0.67 | 0.67 | 0.67 | 0.67 |
| | 25°C | 2.00 | 2.00 | 1.34 | 1.78 |
| | 28°C | 0.67 | 0.67 | 1.33 | 0.89 |
| 8 hours | 23°C | 0.67 | 0.67 | 2.00 | 1.11 |
| | 25°C | 2.00 | 1.34 | 1.34 | 1.56 |
| | 28°C | 1.37 | 2.00 | 3.33 | 2.23 |
| 12 hours | 23°C | 0.67 | 0 | 2.67 | 1.11 |
| | 25°C | 1.34 | 0.67 | 4.67 | 2.23 |
| | 28°C | 0.67 | 2.67 | 0.67 | 1.34 |
| Average of experimental batches | | 1.12 | 1.19 | 2.00 | 1.44 |
| Control batch (3,7 or 14 days storage, no preheating) | | 1.33 | 0.67 | 2.00 | 1.33 |

At the eggs stored for 7 days, the proportion of dead embryos in phase III was of 1.78% at the experimental batches and 1.33% in control batch, preheating of the eggs had beneficial effects on the embryonic mortality.

Table 4. Dead embryos in phase III (16 -21 days) depending on the storage period of eggs (%)

| Preheating program | | Storage period (days) | | | Average |
|---|------|-----------------------|------|------|---------|
| | | 3 | 7 | 14 | |
| 4 hours | 23°C | 3.34 | 2.00 | 5.34 | 3.56 |
| | 25°C | 2.00 | 2.00 | 5.34 | 3.11 |
| | 28°C | 0 | 2.67 | 2.67 | 1.78 |
| 8 hours | 23°C | 1.34 | 0.67 | 6.00 | 2.67 |
| | 25°C | 4.00 | 0 | 5.34 | 3.11 |
| | 28°C | 2.00 | 1.34 | 2.67 | 2.00 |
| 12 hours | 23°C | 1.34 | 2.00 | 5.34 | 2.89 |
| | 25°C | 3.34 | 2.67 | 2.00 | 2.67 |
| | 28°C | 2.67 | 2.67 | 3.34 | 2.89 |
| Average of experimental batches | | 2.22 | 1.78 | 4.23 | 2.74 |
| Control batch (3,7 or 14 days storage, no preheating) | | 3.33 | 1.33 | 5.33 | 3.33 |

Instead, the old eggs, which were kept for 14 days before being placed in incubation, the percentage of dead embryos in phase III it was significantly higher in eggs without preheating, of 5.33% compared with the preheated ones, of 4.23, the differences from batches being of 1.10%.

Viability of hatched chicks. Viability of all batches of chicken have been considered high, regardless of the duration of storage eggs. Total average values were of 98.34% for the experimental batches and 99.21% for control batch, the difference was of 0.87% (Fig. 1).

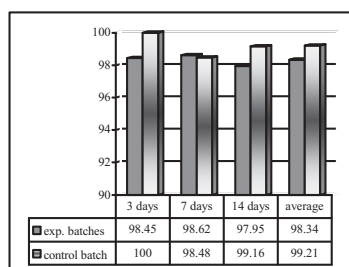


Fig. 1. Viability of hatched chicks according to the period of eggs storage (%)

From the data presented in Fig. 1 can be seen that close to 100% viability of hatched chicks were obtained from all periods of storage of eggs, which leads us to believe that the viability of chicken is not influenced by age but is more about the respect for incubation technology itself.

Optimum efficiency of the chicken is between 67-68%. In most variants presented experimental results were obtained falling within this range. Values greater than 69% were recorded in batches of chickens which came from eggs stored for 14 days (Fig. 2).

The lowest yield was recorded on chicks who came from eggs stored for a week, of 68.45%. Optimum efficiency of the chicken then increased to 68.79% in offspring derived from eggs stored for 3 days and reached up to 69.24% in chickens from two weeks old egg. In all cases it is considered that normal values are achieved. Return to the chicken, the optimum efficiency of the chicken is influenced by the duration of eggs storage. The manufacturer agrees that in studied hybrid, optimum efficiency of chicken increases by 0.5% per week of hatching egg storage, thus leading to

the eggs stored for 2 weeks, resulting in optimum efficiency of chickens these eggs to be of 69%.

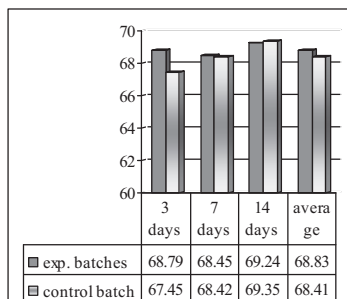


Fig. 2. Optimum efficiency of the chicken depending on the storage period of eggs (%)

Differences between control batches of eggs who had not been preheating and those from the experimental periods who have different levels of preheating, were very small, from 68.83% to 68.41%, being only 0.42%. This shows that optimum efficiency of the chicken performance is influenced in a higher proportion by the age and storage conditions of eggs and their only warm-applied treatment of hatching eggs.

Hatchability. Highest hatchability of incubated eggs from Ross 308 hybrid has been those batches who have been kept for seven days and have suffered treatment for preheating, of 94.11% (Table 5, Fig. 3). Eggs of the same age, but were not preheated, conducted a hatchability percentage of 93.62%, with 0.49% less. Batches stored for 3 days showed good values of hatchability, by 93.59% in experimental batches to 92.47% to the control batch. The lowest values of hatchability percentage were recorded at 14 days old eggs. They had an hatchability of 85.64% on the batches of eggs that were treated by preheating and 82.07% in the control batch. Noteworthy is the fact that hatchability decreased by 5.58% to average on eggs of two weeks old, where was performed preheating and by 7.32% in the control batch.

Hatching percentage. The averages values made by analyzed batches of the hatching percentage was of 87.83% for eggs with preheating treatment and 85.78% to those from the control batch.

Table 5. Hatchability eggs incubated according to their storage period (%)

| Preheating program | Storage period (days) | | | Average | |
|---|-----------------------|-------|-------|---------|-------|
| | 3 | 7 | 14 | | |
| 4 hours | 23°C | 93,75 | 95,89 | 82,14 | 90,59 |
| | 25°C | 92,52 | 91,67 | 84,29 | 90,49 |
| | 28°C | 94,52 | 94,56 | 80,95 | 90,01 |
| 8 hours | 23°C | 94,44 | 94,41 | 88,36 | 92,40 |
| | 25°C | 91,89 | 95,14 | 88,81 | 91,95 |
| | 28°C | 93,10 | 93,75 | 85,62 | 90,82 |
| 12 hours | 23°C | 93,75 | 96,60 | 85,31 | 91,89 |
| | 25°C | 93,06 | 92,47 | 86,98 | 90,84 |
| | 28°C | 95,24 | 92,46 | 88,28 | 91,99 |
| Average of experimental batches | | 93,59 | 94,11 | 85,64 | 91,22 |
| Control batch (3,7 or 14 days storage, no preheating) | | 92,47 | 93,62 | 82,07 | 89,39 |

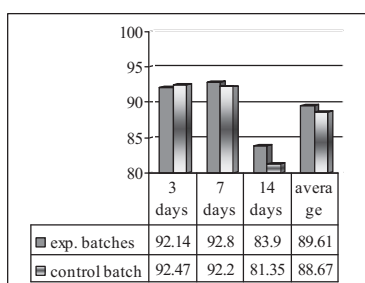


Fig. 3. Hatchability evolution of incubated eggs depending on their storage period (%)

Table 6. The hatching percentage of eggs incubated based on their storage period (%)

| Preheating program | Storage period (days) | | | Average | |
|---|-----------------------|-------|-------|---------|-------|
| | 3 | 7 | 14 | | |
| 4 hours | 23°C | 90,00 | 93,33 | 76,67 | 86,67 |
| | 25°C | 90,67 | 88,00 | 78,67 | 85,78 |
| | 28°C | 92,00 | 92,67 | 79,33 | 88,00 |
| 8 hours | 23°C | 90,67 | 90,00 | 86,00 | 88,89 |
| | 25°C | 90,67 | 91,33 | 79,33 | 87,11 |
| | 28°C | 90,00 | 90,00 | 83,33 | 87,78 |
| 12 hours | 23°C | 90,00 | 94,67 | 81,34 | 88,67 |
| | 25°C | 89,33 | 90,00 | 84,67 | 88,00 |
| | 28°C | 93,33 | 90,00 | 85,33 | 89,55 |
| Average of experimental batches | | 90,74 | 91,11 | 81,63 | 87,83 |
| Control batch (3,7 or 14 days storage, no preheating) | | 90,00 | 88,00 | 79,33 | 85,78 |

What is remarkable is that the hatching percentage has the highest values when the eggs were stored for 7 days and then were preheated of 91.11%. When eggs were stored for 3 days and then were preheated, the hatching percentage was of 90.74% at the

experimental batches and 90.00% in the control group (Table 6, Fig. 4).

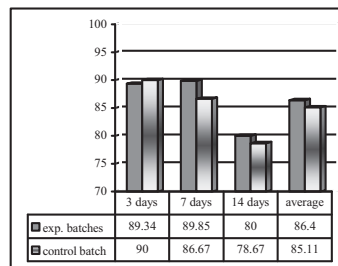


Fig. 4. Evolution of the hatching percentage of eggs incubated based on their storage period (%)

The lowest values of the hatching percentage of eggs were recorded from old ones.

Eggs stored for 14 days have had a hatching rate of 79.33% if was not done preheating and one of 81.63% when this treatment was applied. Both values are lower than the batches averages with 6.20% at the experimental batches and to 6.45% in the control batch.

Table 7. Hatching results of Ross 308 hybrid eggs depending on the studied variables

| Storage period | Preheating program | Parameter (%) | | | | |
|----------------|---|------------------------------|--------------|---------------------|-------|-------|
| | | Viability of hatching chicks | Hatchability | Hatching percentage | | |
| 3 days | 4 hours | 23°C | 99.26 | 93.75 | 90.00 | |
| | | 25°C | 99.26 | 92.52 | 90.67 | |
| | | 28°C | 99.28 | 94.52 | 92.00 | |
| | 8 hours | 23°C | 97.06 | 94.44 | 90.67 | |
| | | 25°C | 97.79 | 91.89 | 90.67 | |
| | | 28°C | 99.26 | 93.10 | 90.00 | |
| | 12 hours | 23°C | 97.78 | 93.75 | 90.00 | |
| | | 25°C | 97.76 | 93.06 | 89.33 | |
| | | 28°C | 98.57 | 95.24 | 93.33 | |
| | 7 days | 4 hours | 23°C | 97.86 | 95.89 | 93.33 |
| | | | 25°C | 97.73 | 91.67 | 88.00 |
| | | | 28°C | 97.12 | 94.56 | 92.67 |
| 8 hours | | 23°C | 98.52 | 94.41 | 90.00 | |
| | | 25°C | 99.27 | 95.14 | 91.33 | |
| | | 28°C | 97.78 | 93.75 | 90.00 | |
| 12 hours | | 23°C | 100.00 | 96.60 | 94.67 | |
| | | 25°C | 100.00 | 92.47 | 90.00 | |
| | | 28°C | 99.26 | 92.46 | 90.00 | |
| 14 days | | 4 hours | 23°C | 99.13 | 82.14 | 76.67 |
| | | | 25°C | 93.22 | 84.29 | 78.67 |
| | | | 28°C | 95.79 | 80.95 | 79.33 |
| | 8 hours | 23°C | 100.00 | 88.36 | 86.00 | |
| | | 25°C | 96.64 | 88.81 | 79.33 | |
| | | 28°C | 99.20 | 85.62 | 83.33 | |
| | 12 hours | 23°C | 100.00 | 85.31 | 81.34 | |
| | | 25°C | 99.21 | 86.98 | 84.67 | |
| | | 28°C | 98.39 | 88.28 | 85.33 | |
| | Average of experimental batches | | 98.34 | 91.22 | 87.83 | |
| | Control batch (3,7 or 14 days storage, no preheating) | | 99.21 | 89.39 | 85.78 | |

CONCLUSIONS

Following the researches made until now in terms of duration and effect of storage conditions on hatching results were obtained the following conclusions:

- Weight loss of incubation eggs during their storage period, was the highest in the eggs kept and stored for 14 days and then preheated for 12 hours at 23°C, of 2.46%. Minimum weight loss of eggs, only 0.17% were recorded in the batches of eggs kept and stored for 3 days, which were then heated for 8 hours at 25°C.
- The lowest embryonic mortality in phase I (1 – 8 days) was of 1.34% in the batches of eggs stored for 3 or 7 days, which were then preheated 4 or 12 hours at 23°C or 28°C. The highest value of dead embryos in phase I has been in the batch of eggs stored for 14 days and preheated for 4 hours at 28°C, of 14.67%.
- Embryonic mortality in phase II (9 -15 days) was nonexistent in the batch of eggs stored for 7 days preheated 12 hours at 23°C. Old eggs, those of two weeks old have been the highest rate of dead embryos in phase II when the preheating batch of eggs was made at 25°C for 12 hours and reached a value of 4.67%.
- Embryonic mortality in phase III (16 – 21 days) was null when the eggs were kept and stored for 3 or 7 days and then preheated to 25°C or 28°C for 4 or 8 hours. Maximum values of embryonic mortality was recorded on old eggs, which were stored for 14 days and then preheated to 23°C for 8 hours, of 6%.
- Optimum efficiency of the chicken had values that were located on all batches within the limits set by the manufacturer of the studying hybrid. Longer can see the fact that the temperature of preincubation did not affect the efficiency of the hatched chicken but the egg storage conditions and duration of the preheating treatment.
- Viability of hatched chicks was considered placed in all batches at high values.
- Hatchability of incubated eggs has been maximum when they were stored for 7 days and then preheated at 23°C for a duration of 12 hours, of 96.60% and have been minimum in the batches stored 14 days and heated then for 4 hours at 28°C, 80.35%. Clear difference of 1.83%, from the average of the experimental

batches and the control batch shows that the preheating treatment of eggs positively influence their hatchability percentage. Duration of storage also influenced eggs hatchability, those batches who were kept and stored less time have been better results compared with those stored for 14 days.

- The hatching percentage of eggs was elevated if the chickens came from eggs which were stored for 7 days. The best combination of factors has emerged in the group of eggs stored 7 days and then preheated 12 hours at 23°C, of 94.67%. Batches of eggs of two weeks old have made small hatching percentage, under the average of the control and experimental batches. The worse combination of factors has been the in the batches of eggs that were kept and stored for 14 days and then preheated at 23°C for 4 hours. In this case fertility rate was of 76.67%.
- Finally, concludes that the batches of eggs that were stored for 3 or 7 days and then incubated, have made the best values of the indices follow its incubation and hatched the chicken quality. The best choice of combination of duration of storage, duration of preheating and the level of preheating of the eggs to obtain the best results in incubation of Ross 308 hybrid were: storage 7 days, preheating for 8 or 12 hours at 23°C or 25°C.
- Elevated incubation parameters have arisen also for the eggs stored for 3 days with the lowest weight loss, the lowest embryonic mortality with values below the batches average.

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